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LABORATORY STUDY ON HYACINTH CONTROL BY THERMAL TRETMENTS

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ABSTRACT

The water hyacinth (Eichhornia Crassipes) is native to South America, but has spread throughout the tropics. In some parts of the world it is a serious pest especially in Egypt. The plant has two or three shiny green squarish leaves, each with an air-filled bladder at the base, to which are attached roots. The bladder keeps the plant afloat. It grows at a prodigious rate, well able to clog lakes and waterways rapidly and leaves quickly covers the water surface. There for it's to be necessary of mechanical, chemical or any other means controls to allow for the extermination of water hyacinth but very few chemical compounds yielded promising results most of the chemical were rejected because of their ineffectiveness or obvious toxicity. The mechanical control is ineffective and very expensive because the vigorously vegetative sexually by budding and stolen production. There fore, the present work were carried out to control the water hyacinth from waterways in Egypt by thermal control. A laboratory studies were conducted to limit the optimum factors to put a design of controlling device for further work. A quick means of evaluating the pattern controlling of hyacinth was provided. The effect of some factors, such as the average of bladder diameter (25; 30; and 35mm); resting time (four levels with intercept of one minute) and oven temperatures (200, 230,260 and 290^{0}C) on controlling pattern, was investigated. The attained results indicated that the use of oven temperature (290^o) and resting time of 4 minutes at average bladder diameter of 25 mm gave the best controlling performance.

INTRODUCTION

One of the fastest growing plants knows water hyacinth reproduce primarily by way of runner, which eventually plants. The common water hyacinth (*Eichhornia Crassipes*) is a vigorous grower to double its population in two weeks.

Herfjord *et al.* (1994) indicated that, water hyacinth is an aquatic plant which can live and reproduce floating freely on the surface of fresh waters or can be anchored in mud. Plant size ranges from a few inches to a meter in height. Its rate of proliferation under certain circumstances is extremely rapid and it can spread to cause infestations over large areas of water causing a variety of problems. It grows in mats up to 2 meters thick which can reduce light and oxygen, change water chemistry, affect flora and fauna and cause significant increase in water loss due to evaportranspiration. It also causes practical problems for marine transportation, fishing and at intakes for hydro power and irrigation schemes. It is now considered a serious threat to biodiversity.

Grodowitz (1998) showed that, water hyacinth (Eichhornia Crassipes) is a member of the pickerelweed family (Pontederiaceae). The glossy green, leathery leaf blades are attached to petioles that are often spongy-inflated. Water hyacinths grow over a wide variety of wetland types and obtain their nutrients directly from the water. New plant populations often form from rooted parent plants and wind movements and currents help contribute to their wide distribution. Water hyacinth reproduces sexually by seeds, vegetative and daughter plants sprout doubling times have been reported of 6-18 days. The seeds can germinate in a few days or remain dormant for 15-20 years. Mechanical controls such as harvesting have been used for nearly 100 years in Florida, but are ineffective for large scale control, very expensive, and cannot keep pace with the rapid plant growth in large water systems. Three insects have been released for the biological control of water hyacinth.

Ramey *et al.* (2003) showed that while machines may be preferred in certain situations, a variety of disadvantages limits their more general use for controlling invasive plants in Florida's water bodies. Today, plant managers generally restrict the use of mechanical controls to small or where chemical, biological, and physical (non-mechanical) means of control are not practical. The machines generally are expensive, low efficiency and productivity and requiring frequent maintenance and repairs. Vegetation cans germination quickly, necessitating frequent repeated treatments throughout a single growing season. Native plants removed by machines are disadvantaged as invasive plants germination faster than native species and are able to re-colonize an area more quickly. To remove vegetation from the waterway means plant mangers must locate suitable areas in which to dispose of large amounts of plant material.

Upadhyay (2007). Abou-Shanb (2007). Skinner (2007). Maine (2006).

The plant is extremely tolerant towards ,and of high capacity of up- taking heavy metals , such as Cd, Cr ,Co ,Ni ,Pb and Hg etc ,which could be utilized for the bio-cleaning of indu strial waste water , Ebel A. (2007). not only the heavy metals (Eichhornia Crassipes) can also remove toxins such beneficial in areas that have endured gold mining operations .

Glenn (2005) mentioned that, there are two different kinds of ovens that are used in a household today. One type would be the gas oven. The gas oven has a gas line coming in from the back of the oven. The oven uses the gas as a method of fueling the flame. Another kind of oven would be the electric oven. Also, he added that oven temperatures usually range from 400 °K (127°C/260°F) to 500 °K (227 °C/440°F) for baking, broiling, and etc. The ovens differ according to the type of oven it is, the fuel used, and variability in power, the oven has made cooking today much easier and faster.

Kateregga Eseza and Thomas (2007) showed that the water hyacinth (Eichhornia Crassipes), originally a South American plant, is among the ten most notorious weeds in the world and is capable of doubling its mass in 14 days. Opande *et al.* (2004) and Lvemp (2004) indicated that water hyacinth effects the Lake Victorian population in many negative ways. There are economic impacts when the weeds block boat access and it effect on transportation and fishing is immediately felt.

The main aims of the present study were to:

1-Investigate a new methods to reduce the re-growing of water hyacinth by thermal control. And recommend the simple and effective technique to thermal control water of hyacinth from the water way for further work
2- Attaining the optimum oven temperature and resting time during average bladder diameter
3- Minimize the growing plants after thermal control method in comparison to mechanical, chemical and other methods to reduce the re-growing ratio and environmental pollution.

MATERIALS AND METHODES

The experiments ware evaluated and tested at Institute for Efficient Productivity Zagazig University. Four levels of oven temperature namely 200; 230; 260 and 290ºC) and three levels of resting time (1; 2; 3 and 4 minutes) for hyacinth in oven under different temperature for three levels of average bladder diameters (25, 30 and 35mm) ware conducted as variables parameter. To control the water hyacinth, the re-growing percentage (RG, %) were recorded.

The Used Temperature Oven

Electric oven model MR170E made in German temperature range up to 1200ºC. It consists of group of parts as shown in figure1. It has gross dimensions 0.50 m wide, 0.65 m high 0.55 m long. The front of oven takes a cylindrical shape with diameter of 0.47 m. its specification are current of 220 Volt, 13.8 Ampere and 3 kW. The temperature degree adjusted by thermostat ranged from zero to 1200ºC with increment of 10ºC. It provided with indicator to show the adjusted temperature degree. A door of 23x15 cm used to input and out put the samples. A sample tray (16 x 28cm) used for putting the sample in the oven that putting in rectangular hole (17.5 x 9cm).

The Lab Experiments

The general view of Hyacinth illustrated in figure (2) The lab experiments were carried out using thermal controlling to evaluate the performance of re-growing percentage (RG, %) requirement for all controlling method operations. For different treatments five replicates were measured and evaluate the RG% by putting the samples in water at five, ten, fifteen and twenty days after temperature controlling (figure-3).

Fig. (1): The used oven in operation

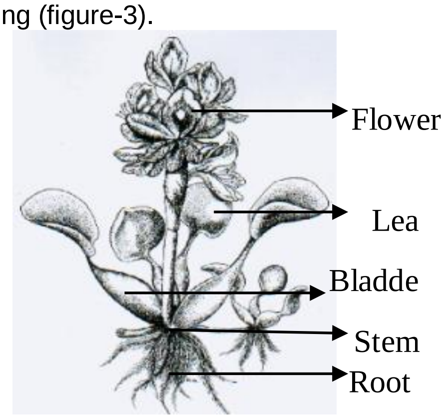


Fig. (2): Component of water hyacinth

Re-Growing Percentage, %

The re-growing percentages (figure 3) from each replicate for thermal controlling method were determined by using the following equation:

$$RG = \frac{n}{N} \times 100$$

Where:

RG = re-growing, (%),
N = Number of plants in every sample,
n=Number of re-growing plants

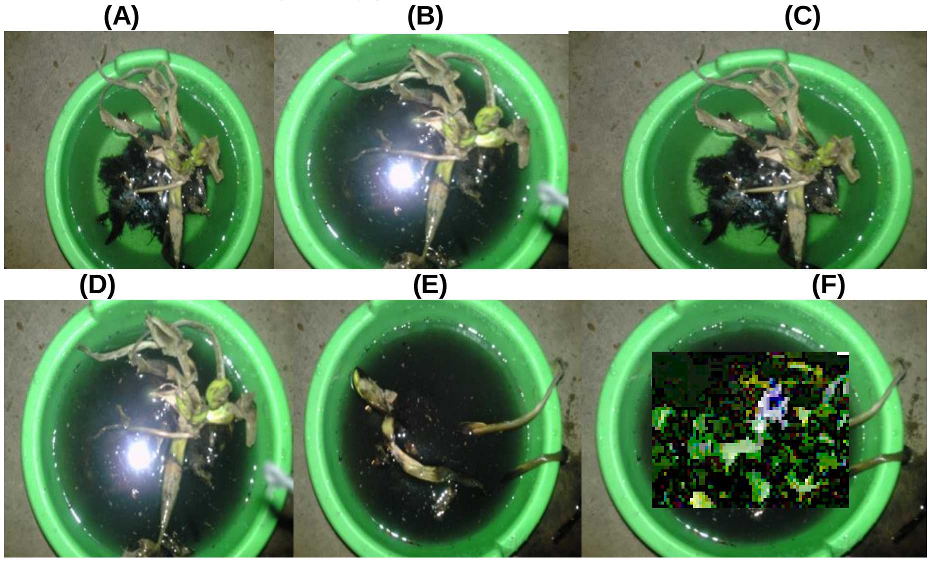


Fig.(3) Five replicates at oven temperature 290oC, resting time of 3 minutes and the average of bladder diameter of 30 mm after twenty days from treatment of re-growing at B and D of 40% and (F) before treatment.

Statistical analysis

Analysis of variance and goodness of fit thermal control during analyzing the collected data in the present study are conducted. Analysis was executed with the aid of the computerized statistical procedures of SPSS (version 9) program. The general regression equation for all variables was calculated.

RESULTS AND DISCUSSION

Effect of the tested factor on the plant re-growing (%)

Figures from 4 to 7 show that the effect of thermal treatments on re-growing percentage of hyacinth at different factors under study. The lowest re-growing percentage (RG, %) zero percentage (the max. influence of thermal control) achieved at oven temperature 290 ^{0}C, resting time 3 and 4 minutes at average bladder diameters of 25mm and 30mm respectively after 20 dyes of re-growing period in water. But the highest re-growing percentage 100% (the min. influence of thermal control) attained at oven temperature 200

^{0}C and resting time one min. at any average of bladder diameter after 20 dyes of re-growing period in water.

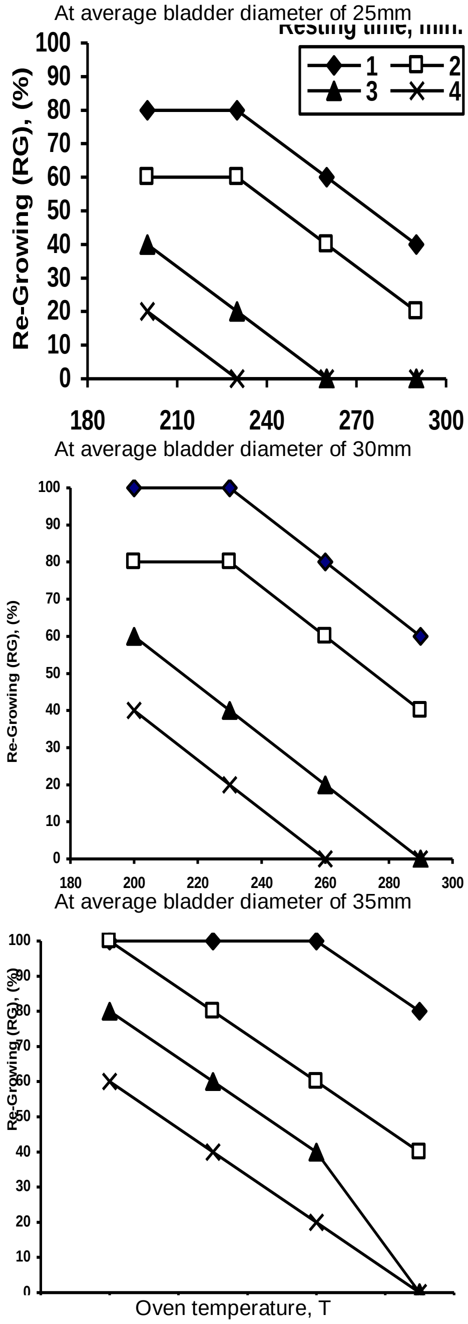


Fig. 4. Effect of different tested factors on re-growing (%) after five days of re-growing period in water.

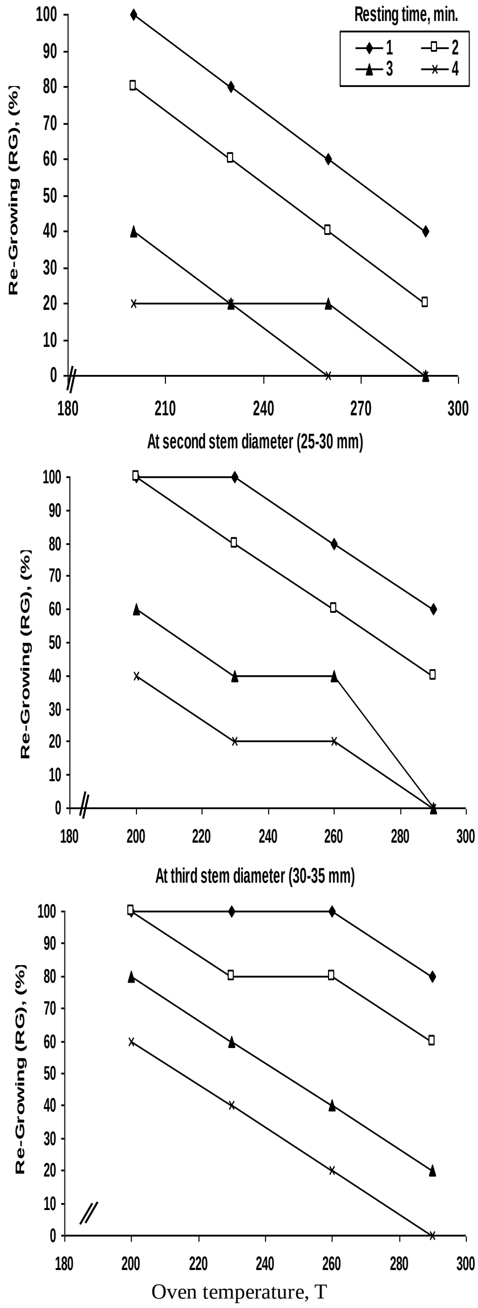
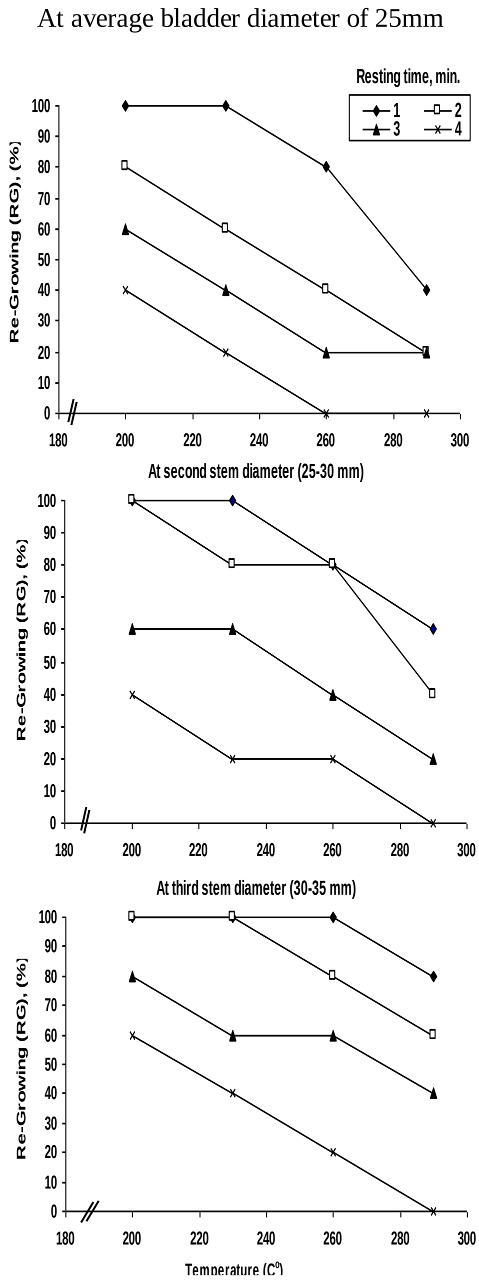


Fig. 5. Effect of different tested factors on re-growing (%) after ten days of re-growing period in water.



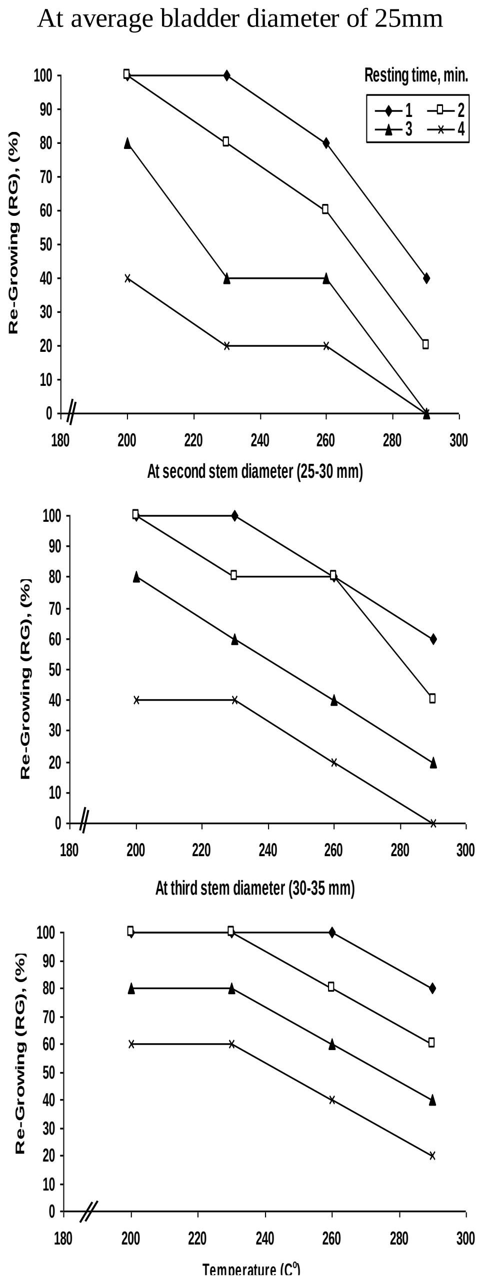


Fig.6: Effect of different tested factors on re-growing (%) after fifteen days of re-rowing period in water

Fig.7: Effect of different tested factors on re-growing (%) after twenty days of re-rowing period in water.

The results indicated that increasing oven temperature from 200^0C to 290^0C cause corresponding decrease in re-growing percentage (RG,%) from 40% to zero% at fourth resting time and the average bladder diameters 25 and 30mm after 20 dyes of re-growing period in water. Also, the results indicated that "GR, %" decreases from 60 t0 20% for the average of bladder diameters 35mm at the same mention parameters. The increasing in "RG,%" when the average of bladder diameter increases the moisture content inside the plant increase that led to reduce the influence of thermal treatments on cytoplasm in side the cells.

A mathematical model is derived to describe the re-growing of water hyacinth as effecting by oven temperature control (T), resting time (E), average of bladder diameter (D) and re-growing period in water (P). The model was derived based on average data of re-growling percentage that obtained from lab experiment. The developed model is expressed as follows:

$$\mathbf{RG, \% = 147.9792 + (1.0333*P) + (2.3438 *D) - (21.25 * E) - (0.50833 * T)}$$

The coefficient of determination (R2) of developed model is 0.946. The above model valid for temperatures ranged from 200 to 2900C and at resting times in oven from 1-4 minutes. The above regression equation showed that increasing oven temperature one degree decreased the re-germination percentage "RG, %" about 0.508% at constant all other treatments. While increasing the plants resting times in oven one minute decreased the "RG,%" by about of 21.25 %, but at increases the stem diameter of 5 mm increased the re-germination percentage of 2.34 % at assuming the all other parameters is constant. From the same regression analysis noticed that the highest positive effective factors was the resting time.

The resting times has standardized coefficient of 75 % followed oven temperature has standardized coefficient of 50.6 % followed average of bladder diameter cause negative effect has standardized coefficient of 33.5%.

Fig. (8) represents the relationship between actual "RG,%" and predicated models estimate from above equation. The figure (8) indicated that may be use the investigated equation model in range of 25 to 35 mm of bladder average diameters.

The average of re-growing percentage

The average of re-growing percentage at different diameters as the relationship between the thermal treatments (200; 230; 260 and 290 0C) and the re-growing Hyacinth percentage at different resting tines in oven are illustrated in figure (9). Generally, increasing each of the thermal temperature (T, 0C) and resting times (E, min) the re-growing percentage (RG, %) is decreases. The lowest hyacinth RG, (0%) achieved at oven temperature 290o, resting time of 4 minutes and stem diameter of 25 mm. But the highest hyacinth re-growing (100%) attained at oven temperature 200oC, one minute and the average of stem diameter of 30 or 35 mm. This means that, there are direct proportional among the oven temperature (T, 0C) and the resting time (E) on hyacinth re-growing percentage. On the other hand, increasing the average diameters of bladder increases the thermal resistance consequently, the re-growing percentage decreased. This may be due to increasing the bladder diameter led to increment of water inside the plant taking more times of exposing even evaporates.

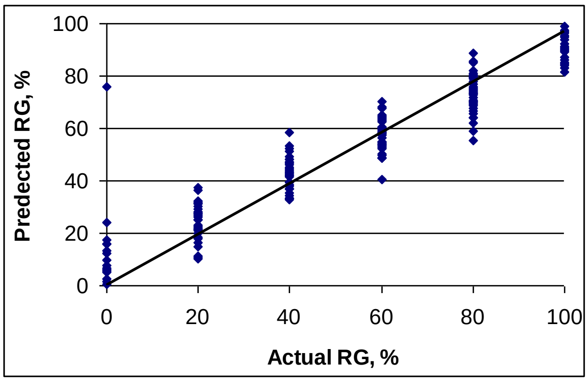


Fig. (8): Variation between the predicted and actual "RG,%"

CONCLUSION

1. The lower re-growing percentage of hyacinth control obtained at oven temperature 290 °C, time of exposing 4 minutes and the average of bladder diameter 25 mm. While the highest hyacinth thermal control ratio (100 %) achieved at oven temperature 200 °C, time of exposing 1 minute and the average of bladder diameter 35 mm.
2. The mentioned optimum operating conditions of the suggested controlling method were found to be as follows; the oven temperature 290 °C, time of resting time 4 minutes and the average of bladder diameter 25 mm. The results of this article may recommend that using the new suggested this idea to develop conveyor machine to be transferring the hyacinth to high temperature oven (290°C) after reducing the water to destroy and kill its cells and throwing it in the water way to reduce the environmental pollution.

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دراسة معملية على مقاومة ورد النيل بالحرارة

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عشب الماء (أو ورد النيل) هو نبات مائي موسمي موطنه الأصلي المناطق الإستوائية بأمريكا الجنوبية وهو ينمو بكثافة عالية ويطفو فوق المياه العذبة لدرجة انة يغطى سطح المجارى المائية مسببا مشاكل كثيرة فى دول حوض النيل ومن بينها مصر وذلك بتبخير كميات هائلة من الماء الصالح للزراعة، واعاقة حركة الملاحة والري وانسداد المجاري المائية. كما أنه يستهلك الأكسجين الذائب في المياه مما يهدد حياة الأسماك والكائنات المائية. بالإضافة إلى أنه يأوي العديد من القواقع مثل قواقع البلهارسيا، والزواحف والثعابين.

بعض الأبحاث أكدت أأن العناصر الثقيلة والسامة تتركز بجذور النبات، كما أن أكثر الأبحاث علي مستوى العالم(حتى الآن) تؤكد علي التخلص من ورد النيل فالصناعات التي تقوم عليه لا

توازي المخاطر والأضرار التي يسببها. ورغم قدم هذه المشكلة فإن كافة الطرق التى إستخدمت لمكافحة ورد النيل لم تفلح للقضاء عليه نهائياً ولذلك تمت هذه الدراسة على أسس جديدة لمكافحة ورد النيل.

وتمت الدراسة فى المعمل على فرن ألمانى ماركة Heraeus يوفر درجة حرارة من ٠ إلى ١٢٠٠م° ويعمل بالتيار الكهربى العادى ٢٢٠ فولت وتمت التجارب فى معمل الأراضى بمعهد الكفاية الإنتاجية بجامعة الزقازيق بمحافظة الشرقية. وتم إختيار عوامل الدراسة كما يلى:

١. درجة حرارة الفرن (٢٠٠-٢٣٠-٢٦٠-٢٩٠ م°) .
٢. زمن تعرض النبات للحرارة داخل الفرن (١-٢-٣-٤ دقيقة).
٣. متوسط قطر الساق الهوائية (٢٥- ٣٠ - ٣٥ مم).

تم دراسة إمكانية مكافحة نبات ورد النيل بعد المعاملة الحرارية وتحت عوامل الدراسة السابقة وذلك بإعادة إستبات النباتات فى الماء بعد كل معاملة لمدة (٥، ١٠، ١٥، ٢٠ يوم) حيث تكررت كل معاملة ٥ مرات وحسبت النسبة المئوية للنباتات التى أعيد إستنباتها (كدليل على مدى نجاح مقاومة ورد النيل بالحرارة) من ناتج قسمة النباتات التى أعيد إستنباتها على إجمالى عدد النباتات فى المكررة الواحدة وذلك عند كل معاملة على حدة.

تحققت أقل نسبة إعادة إستنبات لنبات ورد النيل (٠,٠%) عند ٢٩٠ م ْ وزمن تعرض داخل الفرن ٤ دقائق ومتوسط قطر الساق الهوائية ٢٥ مم. وكانت أعلى نسبة إعادة إستنبات ورد النيل (١٠٠%) عند ٢٠٠ م ْ وزمن تعرض داخل الفرن ١ دقيقة ومتوسط قطر الساق الهوائية ٣٥ مم. وبناءً على ما سبق نوصى فى دراسات لاحقة بتصنيع ألة بسيطة مزودة بحصيرة لنقل النباتات من المياه إلى فرن على درجة حرارة ٢٩٠ م ْ وزمن تعرض ٤ دقائق حيث يتم ضبط سرعة الحصيرة بحيث تمر فى الفرن فى حوالى أربعة دقائق وتلقى النباتات بعد مقاومتها حرارياً فى المياه حيث لا تنبت ثانية. ويفضل مقاومة النبات فى الأعمار المبكرة (متوسط قطر الساق الهوائية ٢٥ مم). حيث تتميز هذه الطريقة عن الطرق الأخرى فى الإبادة التامة للنبات عند العوامل الموصى بها وأنها أقل الطرق تكلفة وتلويثاً للبيئة. حيث يعيب الطريقة الميكانيكية التكلفة العالية وإعادة إنبات ورد النيل بينما الطريقة الكيمائية يعيبها التأثير على الكائنات النافعة الأخرى وتلويثها للبيئة والطريقة البيولوجية مكلفة جداً ولها أثار جانبية.

The bladder average diameter of:
25 mm 30 mm
35 mm

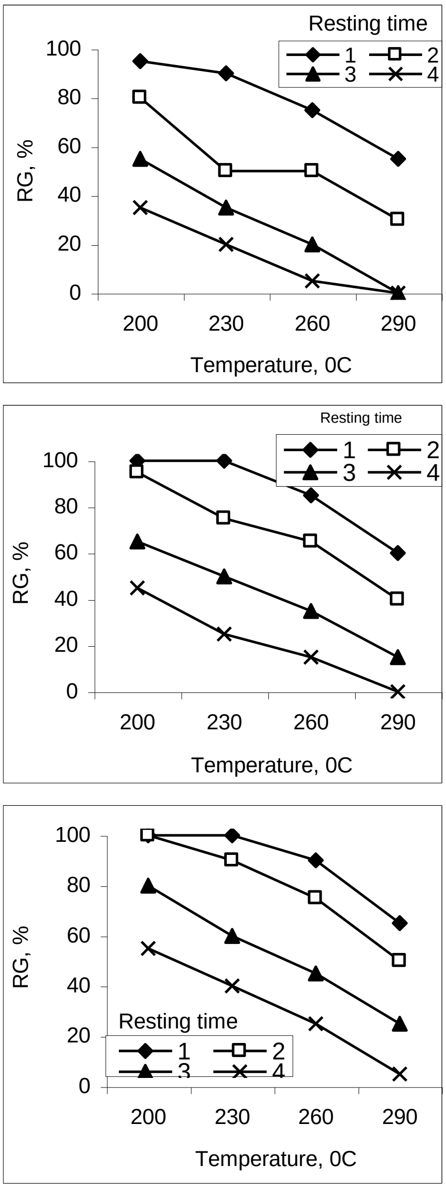

Fig. (9): The thermal treatments via hyacinth re-growing (%).